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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/675,627	09/29/2000	Michael Rumer	M-8570 US	9578
34036	7590	09/10/2004	EXAMINER	
SILICON VALLEY PATENT GROUP LLP 2350 MISSION COLLEGE BOULEVARD SUITE 360 SANTA CLARA, CA 95054			PERKINS, PAMELA E	
			ART UNIT	PAPER NUMBER
			2822	

DATE MAILED: 09/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/675,627

Applicant(s)

RUMER ET AL.

Examiner

Pamela E Perkins

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 May 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 11-17 is/are allowed.
- 6) ☒ Claim(s) 1-8 and 18-30 is/are rejected.
- 7) ☒ Claim(s) 9 and 10 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the filing of the request from reconsideration filed on 24 May 2004. Claims 1-30 are pending.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claims 1, 2, 4, 23 and 30 are rejected under 35 U.S.C. 102(e) as being anticipated by Wada et al. (6,440,843).

Wada et al. disclose a method of forming a titanium layer on a substrate comprising placing a substrate in a physical vapor deposition chamber, the chamber comprising a titanium target; causing hydrogen to be absorbed into the titanium target; introducing an inert gas into the chamber; and igniting a physical vapor deposition

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plasma in the chamber, the physical vapor deposition plasma causing the hydrogen to be released from the titanium target, causing the hydrogen to be activated, and causing a titanium layer to be deposited onto the substrate, wherein after the hydrogen is released from the target, the hydrogen reacts with a species adsorbed in the substrate (col. 90, lines 53-60). Wada et al. further disclose the source of titanium is a sputtering target and wherein depositing the titanium layer onto the substrate is sputter depositing the titanium layer by applying power to the sputtering target (col. 90, lines 53-65).

Wada et al. also disclose the atmosphere comprising argon and hydrogen (col. 90, lines 57-59).

Claims 1, 2, 23 and 30 are rejected under 35 U.S.C. 102(b) as being anticipated by Takayama (5,466,539).

Takayama discloses a method of forming a titanium layer on a substrate comprising placing a substrate in a physical vapor deposition chamber, the chamber comprising a titanium target; causing hydrogen to be absorbed into the titanium target; introducing an inert gas into the chamber; and igniting a physical vapor deposition plasma in the chamber, the physical vapor deposition plasma causing the hydrogen to be released from the titanium target, causing the hydrogen to be activated, and causing a titanium layer to be deposited onto the substrate, wherein after the hydrogen is released from the target, the hydrogen reacts with a species adsorbed in the substrate (col. 2, lines 16-34). Takayama further discloses the source of titanium is a sputtering target and wherein depositing the titanium layer onto the substrate is sputter depositing the titanium layer by applying power to the sputtering target (col. 2, lines 16-34).

Claims 1, 2, 4, 23 and 30 are rejected under 35 U.S.C. 102(b) as being anticipated by Teng et al. (5,958,543).

Teng et al. disclose a method of forming a titanium layer on a substrate comprising placing a substrate in a physical vapor deposition chamber, the chamber comprising a titanium target; causing hydrogen to be absorbed into the titanium target; introducing an inert gas into the chamber; and igniting a physical vapor deposition plasma in the chamber, said physical vapor deposition plasma causing the hydrogen to be released from the titanium target, causing the hydrogen to be activated, and causing a titanium layer to be deposited onto the substrate, wherein after the hydrogen is released from the target, the hydrogen reacts with a species adsorbed in the substrate (col. 2, lines 35-48). Teng et al. further disclose the source of titanium is a sputtering target and wherein depositing the titanium layer onto the substrate is sputter depositing the titanium layer by applying power to the sputtering target (col. 4, lines 30-51). Teng et al. also disclose the atmosphere comprising argon and hydrogen (col. 1, lines 12-19).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wada et al.

Wada et al. disclose the claimed invention except for absorbing the hydrogen to a depth of about 50 Angstroms into the titanium target. It would have been obvious to one having ordinary skill in the art at the time invention was made to absorb the hydrogen to a depth of about 50 Angstroms into the titanium target, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Claims 3, 18, 20, 21 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wada et al. in view of Yamadai (6,083,830).

Wada et al. disclose the subject matter claimed above except the titanium layer having a <002> orientation, the titanium nitride layer having a <111> orientation and the aluminum layer having a <111> orientation.

Yamadai discloses a method of forming a layer on a substrate where a titanium layer (3), with a <002> orientation, is sputter deposited on a substrate (1), then a titanium nitride layer (4), with a preferred <111> orientation, is formed on the titanium layer (3) and an aluminum layer (5), with a <111> orientation, is formed on the titanium nitride layer (4) (col. 3, line 17 thru col. 5, line 41; col. 5, lines 1-33).

Since Wada et al. and Yamadai are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Yamadai would have been recognized in the pertinent art of Wada et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wada et al. by the titanium layer having a <002> orientation, the titanium nitride

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layer having a <111> orientation and the aluminum layer having a <111> orientation as taught by Yamadai. A titanium layer with a <002> orientation prevents the formation of side-hole, openings in the sidewalls (col. 2, lines 21-55).

Claims 5 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wada et al. in view of Yamadai as applied to claims 1, 2, and 3 above, and further in view of Freeman et al. (5,466,522).

Wada et al. in view of Yamadai disclose the subject matter claimed above except the gas mixture during sputter deposition comprising at least 4 mole percent hydrogen.

Freeman et al. a method of forming a layer over a substrate where a substrate is placed in a sputter chamber containing a gas mixture of argon and hydrogen in the atmosphere and sputter depositing a layer over the substrate. Freeman et al. further disclose the gas mixture comprising at least 4 mole percent hydrogen (col. 4, lines 7-57).

Since Wada et al. and Freeman et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Freeman et al. would have been recognized in the pertinent art of Wada et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Wada et al. by the gas mixture during sputter deposition comprising at least 4 mole percent hydrogen as taught by Freeman et al. The higher the concentration of hydrogen in the atmosphere during sputter deposition there is an increase in the coercivity of the film formed on the substrate, meaning the polarity of the material changes only under the influence of a relatively large magnetic field (col. 7, lines 7-57).

Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wada et al. in view of Yamadai as applied to claims 1, 2 and 3 above, and further in view of Kaloyeros et al. (6,139,922).

Wada et al. in view of Yamadai disclose the subject matter claimed above except applying powering to the target with a power density of 0.01 W/cm^2 to 10 W/cm^2 .

Kaloyeros et al. disclose a method of forming a film over a substrate by a method of sputtering. Kaloyeros et al. further disclose the power used in the sputtering method having a power density of between 0.01 W/cm^2 and 10 W/cm^2 (col. 10, lines 60-67; col. 11, lines 1-17).

Since Wada et al. and Kaloyeros et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Kaloyeros et al. would have been recognized in the pertinent art of Wada et al. Therefore, it would have obvious to one of ordinary skill in the art at the time the invention was made to modify Wada et al. by applying powering to the target with a power density of 0.01 W/cm^2 to 10 W/cm^2 as taught by Kaloyeros et al. Under such conditions undesirable film contamination and electrical damage to the film are prevented (col. 11, lines 1-17).

Claims 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wada et al. in view of Yamadai as applied to claims 18 and 20 above, and further in view of Hsu et al. (6,329,282).

Wada et al. in view of Yamadai disclose the subject matter claimed above except the aluminum layer having a FWHM of 1.5 degrees.

Hsu et al. disclose a method of forming a titanium (9), titanium nitride (11), aluminum (19) interconnect. Hsu et al. further disclose the aluminum layer having a FWHM of 1.5 degrees (col. 3, lines 11-65).

Since Wada et al. and Hsu et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Hsu et al. would have been recognized in the pertinent art of Wada et al. Therefore, it would have obvious to one of ordinary skill in the art at the time the invention was made to modify Wada et al. by the aluminum layer having a FWHM of 1.5 degrees as taught by Hsu et al. because it improve the crystallographic orientation of the aluminum layer.

Hsu et al. do not disclose the aluminum layer having a FWHM of less than 1.5 degrees. It would have been obvious to one having ordinary skill in the art at the time invention was made to have a FWHM of less than 1.5 degrees for the aluminum layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Claims 25-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wada et al. in view of Kitch et al. (6,277,726).

Wada et al. disclose the subject matter claimed above except forming an aluminum layer and forming a titanium nitride layer.

Kitch et al. disclose a method of forming a titanium layer on a substrate where a substrate (12) is placed in a deposition chamber comprising a source of titanium, depositing the titanium layer (13) onto the substrate in an atmosphere that comprises

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argon, then forming an aluminum layer (16) on the titanium layer (13). Kitch et al. further disclose forming a titanium nitride layer (15) over the titanium layer (13) (col. 5, lines 6-30).

Since Wada et al. and Kitch et al. are both from the same field of endeavor, a method of forming a titanium layer on a substrate, the purpose disclosed by Kitch et al. would have been recognized in the pertinent art of Wada et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Wada et al. by forming the titanium layer by forming an aluminum layer and forming a titanium nitride layer by Kitch et al. to reducing the resistance of electrical coupling between conductive layers (col. 1, lines 8-11).

Allowable Subject Matter

Claims 9 and 10 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: prior art does not anticipate, teach, or suggest after placing the substrate in the deposition chamber introducing a quantity of hydrogen into the deposition chamber without providing power to the target.

Claims 11-17 are allowed.

The following is a statement of reasons for the indication of allowable subject matter: prior art does not anticipate, teach, or suggest a method of forming a titanium layer on a substrate where the substrate is placed is a sputtering chamber comprising a

titanium target, flowing a first gas comprising hydrogen into the sputtering chamber through a first gas injector, terminating the flow of the first gas, after the flow of the first gas has been terminated, sputter depositing the titanium layer onto the substrate by applying power to the target and by providing a second gas in the sputtering chamber through a second gas inject, wherein the hydrogen is activated and whereby the deposited titanium layer has a preferred crystal orientation.

Response to Arguments

Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Zhang et al. (5,320,984) disclose a method of forming a metal layer on a substrate comprising placing the substrate in a deposition chamber comprising a source of metal, after placing the substrate in the deposition chamber; introducing a quantity of hydrogen into the deposition chamber without providing power to the target; and depositing the metal layer onto the substrate under conditions wherein the atmosphere in the deposition chamber comprises hydrogen and wherein the hydrogen is activated, whereby the metal layer has a preferred crystal orientation, wherein after the hydrogen is released from the target, the hydrogen reacts with a species adsorbed in the substrate (col. 1, line 54 thru col. 2, line 15; col. 5, lines 1-64). Zhang et al. further disclose selecting the metal from group III or IV or V element from the periodic table (col. 3, lines 27-31). Zhang et al. disclose the chamber comprising a

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metal target; causing hydrogen to be absorbed into the metal target; and introducing an inert gas into the chamber, wherein introducing a quantity of hydrogen comprises flowing a gas comprising hydrogen into the deposition chamber (col. 2, line 16 thru col. 3, line 4).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E Perkins whose telephone number is (571) 272-1840. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PEP


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